same two dimensions, that is looking down at the work space, or the two dimensions are in another plane.

[0631] 2. Indeed one could apply a single target capable of being sensed by the tv camera of the invention on the ordinary mouse (or joystick or other input) of today. This could give more degrees of freedom of information, such as angles or movement off the mouse table surface (z direction). For example, a 3D input device can be produced since the camera would provide XZ (z perpendicular to plane of surface) and the mouse would provide XY (in plane of surface_ so therefore you would have all three dimensions.

[0632] 3. Carrying the mouse elaboration one step further, a mouse point could be movable. That is, the target could be wiggled by the finger holding the mouse, to signal a move or other action to the computer. This would then allow you to put inputs to the computer into the device without adding any electrical wires or anything.

[0633] 4. Transducers can also be used as single point inputs, for example of pressures or temperatures or anything that would make a target move, for example in the later case the target being on the end of a bimetal strip which changes position with temperature

[0634] Application to Multiple Points and Objects

[0635] Another application is to register the relative position of one object to another. For example, today the mouse is basically an odometer. It can't really give any positional data relative to something but can only give the distance moved in two directions which is then converted from some home location onto the screen.

[0636] The invention however is absolute, as the camera is as well. It can provide data on any point to any other point or even to groups of points—on objects, humans, or both. Even using the simplest form of the invention, one can put a target on a human and track it or find it's position in space. Here again, in the beginning in for example in two dimensions, X and Y only (**FIG. 1***a*)

[0637] For example, with a single point one can make mouse adjunct where moving one's head with a target on it provides an input into the computer while still holding the mouse and everything in normal juxtaposition

[0638] One step beyond this is to have more than one point on the human. Clearly a finger relative to another finger or a hand relative to another hand, either or both to the head and so on. As has been noted, a method of achieving high contrast and therefore high reliability is to utilize an LED source as the target. This is possible with the invention, but requires wiring on the object, and thus every object that is to be used has to have a power cable or a battery, or a solar cell or other means to actuate the light—a disadvantage if widespread applicability is desired.

[0639] The LED in its simplest form can be powered by something that itself is powered. This means an LED on top of the mouse for example. On the other hand, typically the LED would be on an object where you would not like a power cable and this would then mean battery operated.

[0640] The idea of remote power transmission to the target LED or other self luminous target however should be noted. It is possible to transmit electromagnetic radiation (radio, IR, etc) to a device on an object, which in turn would generate power to an LED which then converts that to DC or modulated light capable of detection optically. Or the device itself can directly make the conversion.

[0641] The basic technical embodiment of the invention illustrated in **FIG. 1** uses a single TV camera for viewing a group of 3 or more targets(or special targets able to give up to a 6 degree of freedom solution), or a set of at least two TV cameras for determining 3D location of a number of targets individually, and in combination to provide object orientation. These cameras are today adapted to the computer by use of the USB port or better still, fire wire (IEE 1394). The cameras may be employed to sense natural features of objects as targets, but today for cost and speed reasons, are best used with high contrast targets such as LED sources on the object, or more generally with retro-reflective targets. In the latter case lighting as with IR LED's is provided near the optical axis of each camera used. For scene illumination, which can be done best on alternate camera frames form target image acquisition, broad light sources can be used. Laser pointers are also very useful for creating one or more high contrast indications, simultaneously, or in sequence on object surfaces that can be sensed by the stereo cameras (typically two or more).

[0642] Using laser (or other triangulation source projection), or the contacting of an object with a targeted finger or stylus member, an object can be digitized using the same camera system used for target related inputs. This is an important cost justification of total system capability.

[0643] Coincidence of action—ie sensed gesture using the invention can be used to judge a voice operated signal legitimate in a noisy background. Similarly other inputs can be judged effectively if combined with the position and movement sensing of the invention.

[0644] Invention combined with voice input makes user much more portable—For example can walk around room and indicate to the computer both action and words The target if a plain piece of glass bead retroreflector, cannot be seen typically beyond angles plus or minus 45 degrees from the normal of the reflector aligned with the camera viewing axis. (indeed some material drops out at 30 degrees) When a performer spins around, this condition is easily exceeded, and the data drops out. For this reason, targets pointing in different directions may be desirable. Rather than using several planar targets with the above characteristics, each pointed in a differnet direction say rotationally about the head to toe axis of a dancer say, one can use in some cases multi-directional targets, typically large balls, beads and faceted objects such as diamonds

[0645] In some case only 3D locations are needed. The orientation at times is a secondary consideration. In these cases the target **1650** could be attached to gyroscope **1655** that in turn is attached to a base **1660** by a ball joint **1665** or other free floating mechanical link. The target could be initially tilted directly toward the cameras allowing the cameras to view the target more precisely. The base plate is then attached to the object to be tracked. The position of the attachment can be calculated once the target location and orientation are established. Since the gyroscope would hold